<u>Amendments to the CLAIMS</u>

1-7. (Cancelled)

8. (Currently amended) A nucleic acid sequence amplification apparatus using PCR, which apparatus comprises:

a plurality of heat sources which supply heat to, or remove heat from a plurality of specific regions in a sample,

wherein the plurality of heat sources are arranged to maintain a spatial temperature distribution in the sample such that a first heat source providing heat to a lower portion of the sample is located lower in height than a second heat source removing heat from an upper portion of the sample and a relatively high temperature region is located lower in height than a relatively low temperature region in the sample,

wherein the spatial temperature distribution comprises spatial regions fulfilling temperature conditions suitable for (i) a denaturation step in which double strand DNAs become separated to single strand DNAs, (ii) an annealing step in which the single strand DNAs formed in the denaturation step hybridize to the primers to form DNA-primer complexes, or (iii) a polymerization step in which the primers in the DNA-primer complexes are extended by the polymerization reaction,

and wherein ~~the spatial temperature distribution is a temperature distribution that induces circulation of the sample by thermal convection so that the denaturation, annealing, and polymerization steps occur sequentially and repeatedly inside the sample,~~ the apparatus further ~~comprising~~ <u>comprises</u> an insulator positioned between the first and second heat sources.

9. (Previously presented) The nucleic acid sequence amplification apparatus of claim 8, wherein at least one of the heat sources comprises a thermally conductive solid in thermal contact with a specific region of the sample; and a heating unit that supplies heat to the thermally conductive solid, or a cooling unit that removes heat from the thermally conductive solid, or a combination of the heating unit and the cooling unit.

10. (Previously presented) The nucleic acid sequence amplification apparatus of claim 8, wherein

at least one of the heat source comprises a liquid in thermal contact with a specific region of the sample; a receptor in which the liquid is to be contained; and a heating unit that supplies heat to the liquid, or a cooling unit that removes heat from the liquid, or a combination of the heating unit and the cooling unit.

11. (Previously presented) The nucleic acid sequence amplification apparatus of claim 10, wherein at least one of the heat sources further comprises a circulation unit that circulates the liquid.

12. (Previously presented) The nucleic acid sequence amplification apparatus of claim 8, wherein at least one of the heat sources comprises a gas in thermal contact with a specific region of the sample; a heating unit that supplies heat to the gas, or a cooling unit that removes heat from the gas, or a combination of the heating unit and the cooling unit; and a circulation unit that circulates the gas.

13. (Original) The nucleic acid sequence amplification apparatus of claim 8, wherein at least one of the heat sources is an infrared radiation generating unit that supplies heat directly to the sample.

14-18. (Cancelled)

19. (Previously presented) The nucleic acid sequence amplification apparatus of claim 8, wherein the plurality of the heat sources comprises a first thermally conductive solid that is in thermal contact with a lower portion of the sample and a second thermally conductive solid that is in thermal contact with an upper portion of the sample.

20. (Previously presented) The nucleic acid sequence amplification apparatus of claim 19, wherein the plurality of the heat sources further comprises a third thermally conductive solid that is in thermal contact with an intermediate portion of the sample in between the upper and lower portions.

21. (Cancelled)

22. (Previously presented) The nucleic acid sequence amplification apparatus of claim 8, wherein the thermal convection is bidirectional.

23. (Previously presented) The nucleic acid sequence amplification apparatus of claim 8, wherein the insulator is a solid, liquid or a gas.

24. (Previously presented) The nucleic acid sequence amplification apparatus of claim 23, wherein the gas is air.

25. (Cancelled)

26. (Previously presented) The nucleic acid sequence amplification apparatus of claim 8, wherein the heat sources are further arranged to provide for a spatial temperature distribution comprising a convection region positioned between the relatively high temperature region and the relatively low temperature region.

27-70. (Cancelled)

71. (Previously presented) The nucleic acid sequence amplification apparatus of claim 8, wherein at least one of the heat sources comprises a heating unit and a cooling unit.

72. (Previously presented) The nucleic acid sequence amplification apparatus of claim 71, wherein the second heat source comprises the heating and cooling units.

73. (Previously presented) The nucleic acid sequence amplification apparatus of claim 8 or 71, wherein the apparatus further comprises an opening defined by the plurality of heat sources and the insulator, the opening being adapted to receive a reaction vessel with the sample.

74. (Previously presented) The nucleic acid sequence amplification apparatus of claim 73, wherein the opening further comprises a closed bottom end within the first heat source.

75. (Previously presented) The nucleic acid sequence amplification apparatus of claim 74, wherein the opening further comprises a first through hole within the second heat source.

76. (Previously presented) The nucleic acid sequence amplification apparatus of claim 75, wherein the opening further comprises a second through hole within the insulator.

77. (Previously presented) The nucleic acid sequence amplification apparatus of claim 73, wherein the opening is essentially perpendicular to the insulator.

78. (Previously presented) The nucleic acid sequence amplification apparatus of claim 73, wherein the opening is configured to receive the reaction vessel configured as a straight cylinder or tube.

79. (Previously presented) The nucleic acid sequence amplification apparatus of claim 78, wherein the reaction vessel is further configured to have a single passage between the relatively high temperature region and the relatively low temperature region.

80. (Previously presented) The nucleic acid sequence amplification apparatus of claim 79, wherein the single passage is adapted to contain an upward and downward convective flow.

81. (Previously presented) The nucleic acid sequence amplification apparatus of claim 78, wherein the reaction vessel is vertical with respect to the heat sources.

82. (Previously presented) The nucleic acid sequence amplification apparatus of claim 78, wherein the reaction vessel is pressurized.

83. (Previously presented) The nucleic acid sequence amplification apparatus of claim 78, wherein the reaction vessel comprises a top end and a bottom end.

84-86. (Cancelled)

87. (Previously presented) The nucleic acid sequence amplification apparatus of claim 83, wherein the bottom end of the reaction vessel is closed.

88. (Previously presented) The nucleic acid sequence amplification apparatus of claim 8, wherein the apparatus further comprises multiple reaction vessels.

89. (Previously presented) The nucleic acid sequence amplification apparatus of claim 8 or 71, wherein the plurality of heat sources are further arranged to produce a vertical gap between the top of the relatively high temperature region and the bottom of the relatively low temperature region.

90. (Canceled)

91. (Currently amended) A nucleic acid sequence amplification apparatus using PCR, which apparatus comprises:

a plurality of heat sources which supply heat to, or remove heat from a plurality of specific regions within an opening configured to receive a reaction vessel and defined by the plurality of heat sources and an insulator,

wherein the plurality of heat sources are arranged to maintain a spatial temperature distribution within the opening such that a first heat source providing heat to a lower portion of the opening is located lower in height than a second heat source removing heat from an upper portion of the opening and a relatively high temperature region is located lower in height than a relatively low temperature region in the opening,

wherein the spatial temperature distribution comprises spatial regions fulfilling temperature conditions suitable for (i) a denaturation step in which double strand DNAs become separated to single strand DNAs, (ii) an annealing step in which the single strand DNAs formed in the denaturation step hybridize to the primers to form DNA-primer complexes, or (iii) a polymerization step in which the primers in the DNA-primer complexes are extended by the polymerization reaction,

~~and wherein the spatial temperature distribution is a temperature distribution that induces~~

~~circulation of sample by thermal convection so that the denaturation, annealing, and polymerization steps occur sequentially and repeatedly inside the sample,~~ the insulator being positioned between the first and second heat sources and in contact with the opening, and further wherein at least one of the heat sources comprises a heating unit and a cooling unit.

92. (Previously presented) The nucleic acid sequence amplification apparatus of claim 91, wherein the opening further comprises a closed bottom end within the first heat source.

93. (Currently amended) A nucleic acid sequence amplification apparatus using PCR, which apparatus comprises:

a plurality of heat sources which supply heat to, or remove heat from a plurality of specific regions in a sample,

wherein the plurality of heat sources are arranged to maintain a spatial temperature distribution in the sample such that a first heat source providing heat to a lower portion of the sample is located lower in height than a second heat source removing heat from an upper portion of the sample and a relatively high temperature region is located lower in height than a relatively low temperature region in the sample,

wherein the spatial temperature distribution comprises spatial regions fulfilling temperature conditions suitable for (i) a denaturation step in which double strand DNAs become separated to single strand DNAs, (ii) an annealing step in which the single strand DNAs formed in the denaturation step hybridize to the primers to form DNA-primer complexes, or (iii) a polymerization step in which the primers in the DNA-primer complexes are extended by the polymerization reaction,

~~and wherein the spatial temperature distribution is a temperature distribution that induces circulation of the sample by thermal convection so that the denaturation, annealing, and polymerization steps occur sequentially and repeatedly inside the sample,~~ and further wherein at least one of the heat sources comprises a heating unit and a cooling unit.

94. (New) The nucleic acid sequence amplification apparatus of claim 91 or 93, wherein at least

one of the heat source comprises a liquid in thermal contact with a specific region of the sample; and a receptor in which the liquid is to be contained.

95. (New) The nucleic acid sequence amplification apparatus of claim 94, wherein at least one of the heat sources further comprises a circulation unit that circulates the liquid.

96. (New) The nucleic acid sequence amplification apparatus of claim 91 or 93, wherein at least one of the heat sources comprises a gas in thermal contact with a specific region of the sample; a heating unit that supplies heat to the gas, or a cooling unit that removes heat from the gas, or a combination of the heating unit and the cooling unit; and a circulation unit that circulates the gas.

97. (New) The nucleic acid sequence amplification apparatus of claim 91 or 93, wherein at least one of the heat sources is an infrared radiation generating unit that supplies heat directly to the sample.

98. (New) The nucleic acid sequence amplification apparatus of claim 91 or 93, wherein the plurality of the heat sources comprises a first thermally conductive solid that is in thermal contact with a lower portion of the sample and a second thermally conductive solid that is in thermal contact with an upper portion of the sample.

99. (New) The nucleic acid sequence amplification apparatus of claim 98, wherein the plurality of the heat sources further comprises a third thermally conductive solid that is in thermal contact with an intermediate portion of the sample in between the upper and lower portions.

100. (New) The nucleic acid sequence amplification apparatus of claim 91 or 93, wherein the thermal convection is bidirectional.

101. (New) The nucleic acid sequence amplification apparatus of claim 91, wherein the insulator is a solid, liquid or a gas.

102. (New) The nucleic acid sequence amplification apparatus of claim 101, wherein the gas is air.

103. (New) The nucleic acid sequence amplification apparatus of claim 91 or 93, wherein the heat sources are further arranged to provide for a spatial temperature distribution comprising a convection region positioned between the relatively high temperature region and the relatively low temperature region.

104. (New) The nucleic acid sequence amplification apparatus of claim 91 or 93, wherein the second heat source comprises the heating and cooling units.

105. (New) The nucleic acid sequence amplification apparatus of claim 93, wherein the apparatus further comprises an opening defined by the plurality of heat sources and an insulator, the opening being adapted to receive a reaction vessel with the sample.

106. (New) The nucleic acid sequence amplification apparatus of claim 105, wherein the opening further comprises a closed bottom end within the first heat source.

107. (New) The nucleic acid sequence amplification apparatus of claim 106, wherein the opening further comprises a first through hole within the second heat source.

108. (New) The nucleic acid sequence amplification apparatus of claim 107, wherein the opening further comprises a second through hole within the insulator.

109. (New) The nucleic acid sequence amplification apparatus of claim 105, wherein the opening is essentially perpendicular to the insulator.

110. (New) The nucleic acid sequence amplification apparatus of claim 105, wherein the opening is configured to receive the reaction vessel configured as a straight cylinder or tube.

111. (New) The nucleic acid sequence amplification apparatus of claim 110, wherein the reaction vessel is further configured to have a single passage between the relatively high temperature region and the relatively low temperature region.

112. (New) The nucleic acid sequence amplification apparatus of claim 111, wherein the single passage is adapted to contain an upward and downward convective flow.

113. (New) The nucleic acid sequence amplification apparatus of claim 110, wherein the reaction vessel is vertical with respect to the heat sources.

114. (New) The nucleic acid sequence amplification apparatus of claim 110, wherein the reaction vessel is pressurized.

115. (New) The nucleic acid sequence amplification apparatus of claim 110, wherein the reaction vessel comprises a top end and a bottom end.

116. (New) The nucleic acid sequence amplification apparatus of claim 115, wherein the bottom end of the reaction vessel is closed.

117. (New) The nucleic acid sequence amplification apparatus of claim 91 or 93, wherein the apparatus further comprises multiple reaction vessels.

118. (New) The nucleic acid sequence amplification apparatus of claim 91 or 93, wherein the plurality of heat sources are further arranged to produce a vertical gap between the top of the relatively high temperature region and the bottom of the relatively low temperature region.

119. (New) The nucleic acid sequence amplification apparatus of claim 91 or 93, wherein at least one of the heat sources comprises a thermally conductive solid in thermal contact with a specific region of the sample; the heating unit supplying heat to the thermally conductive solid, and the cooling unit removing heat from the thermally conductive solid.